

# Module 2: Defining and Using Variables in TreeAge Pro



1. Variables in TreeAge Pro
2. Creating/Managing Variables
3. Variable Scope
4. Variables Extras

53  
2/28/2008

# Variables in TreeAge Pro



54  
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## Variables in TreeAge Pro



- A TreeAge Pro variable is a named quantity
  - Similar to a variable in math, programming, statistics
- A variable has a...
  - **Name**: used as a reference to the variable's value
  - **Definition**: provides a new value for the variable



## Variables in TreeAge Pro



- Benefits of variables in TreeAge Pro
  - Model transparency
    - Naming values using variables makes it easier for you and your colleagues to understand the meaning of numbers inside a model
  - Modeling efficiency
    - Changing a single variable can affect several numeric expressions within a model



## Variables in TreeAge Pro



- Benefits of variables in TreeAge Pro
  - Sensitivity analysis (later, Day 1)
    - Sensitivity analysis on variables can show changes in expected value associated with changes in variable value(s)
    - “2<sup>nd</sup>-order”, parameter uncertainty
  - Cloning (later, Day 2)
    - Identical clones within a model can function differently based on different definitions for the variables used within the clones
  - Trackers & microsimulation (later, Day 2)
    - In complex survival/Markov models, tracker variables can hold patient-level history/state during microsimulation

57  
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## Creating/Managing Variables



- To create a variable in a tree
  1. **Add name** to tree (e.g., “costTxA”)
    - Stick to a consistent naming convention
  2. **Add definition** at a node (e.g., “costTxA=100K”)
    - For now, we will define at the root node
  3. **Use name** in calculation
    - Within a probability, payoff, another variable definition, etc.
    - E.g., replace “100K” in payoffs with “costTxA”

58  
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## Creating/Managing Variables

- Variables can be created...
  - Methodically:
    - Create a list of variables then incorporate those variables into the model
  - As needed:
    - Create and use variables as you create the model
    - Substitute names for numbers in existing tree formulas

59  
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## Creating/Managing Variables

- Naming rules (similar to naming spreadsheet cell)
  - 32 letters/numbers/underscores (no punctuation)
  - Stick to a naming style/convention, perhaps using common prefixes:

● <b>costDrugA</b>	<b>costDrugB</b>	<b>probDeathTxA</b>
● <b>cDrugA</b>	<b>cDrugB</b>	<b>pDeathTxA</b>
● <b>cost_DrugA</b>	<b>cost_DrugB</b>	<b>prob_DeathTxA</b>
● <b>_cost_drugA</b>	<b>_cost_drugB</b>	<b>_prob_DeathTxA</b>
  - Not case sensitive
    - **costDrug == COSTDRUG == costdrug = CostDrug**

60  
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## Creating/Managing Variables

- **Add name to tree and define at node:**

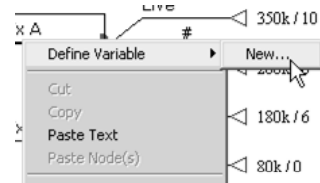
- Quick method:

- **RIGHT-CLICK** on root node (or other node)

- **Define Variable** → **New...**

- Or pick from list of existing names

- **Adds name to tree's list, and adds definition at selected node**



- Or:

- Menu: **VALUES** > **Variables and Tables...**

- Click **New...**, enter **Properties**

- Click **Define Variable ...** > Default for Tree, enter value

61

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## Creating/Managing Variables

- **Tools for methodically creating variable lists**

- **VALUES** > **Variables and Tables...** 

- Set properties and defaults. Use **description** consistently (keep short, for graphs). Use **comment** for long annotation.

- Excel module (optional, later)


- Tree outlines

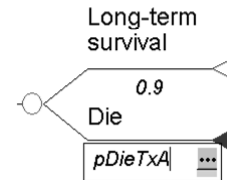
- Node Outline pane – new in v2007



## Creating/Managing Variables



- After you have added **names** to tree, and **defined** at correct node...
- **Use in calculation:**
  - Carefully: **Mistyping the name** creates a different variable.
  - Use the tools...
    - VALUES > Insert Variable... ( CTRL + i )
    - VALUES > Formula Editor...  includes Variables dropdown menu



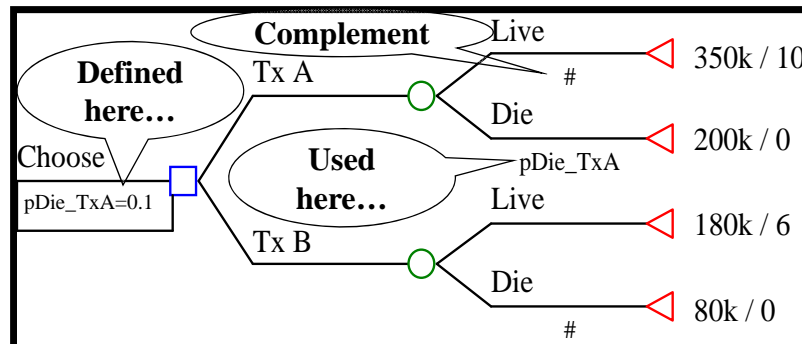
63  
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## Creating/Managing Variables



- Review
  - Name, define, and use:



64  
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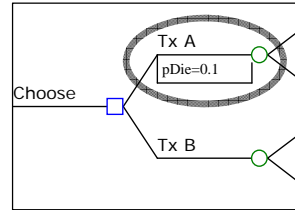


## Creating/Managing Variables



- Definition **display** at nodes

- Variable definitions presented in box below the node, but *above* probability (no box)



- EDIT > Preferences... **F11**

- Category “Variables/Markov Info”
- Show/hide definitions
- Expand node to fit defs; wrap long defs

65  
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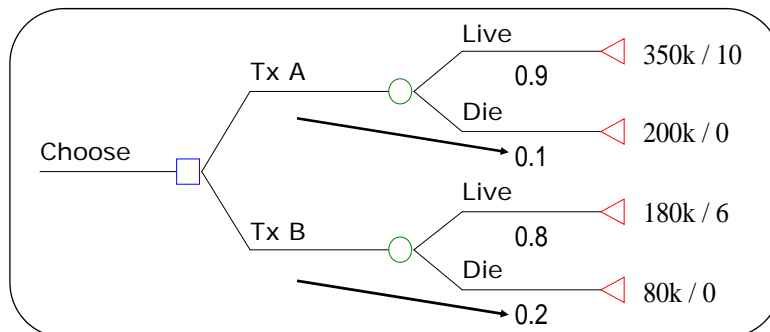


## Creating/Managing Variables



- Example 2: Part 1

- Start with tree from Example 1 (save with new name)
- Incorporate variables for the initial probability of dying from Tx A and Tx B



66  
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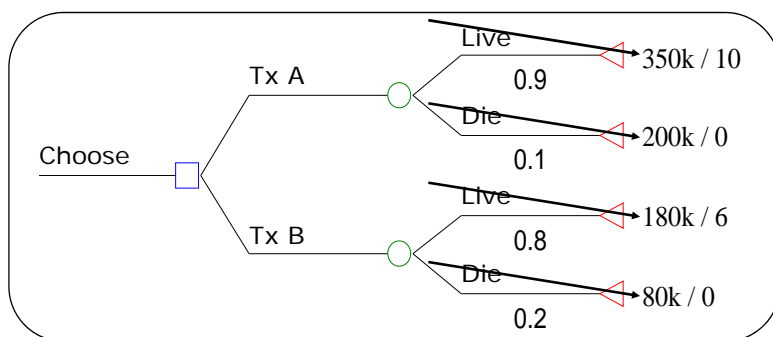


## Creating/Managing Variables



- Example 2: Part 2

- Break down each treatment's cost into two components (immediate and ongoing)
- Incorporate new variables into the payoff calculations



67  
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## Creating/Managing Variables



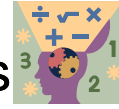
- Example 2: Part 1

1. Right-click on root node
2. Select Define Variable > New from the menu
3. Enter the variable name (pDie\_TxA) and description (optional)
4. In the formula editor, enter the variable value (0.1)
5. Repeat 1-4 for TxB with the appropriate name/value (pDie\_TxB/0.2)
6. Replace the two probabilities of death in the tree with the new variables
7. Replace the probabilities of survival with the complement indicator (#)

68  
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## Creating/Managing Variables



- Example 2: Part 2
  1. Right-click on TxA node
  2. Select Define Variable > New from the menu and create each of the following variables
    1.  $cInit\_TxA = 200K$
    2.  $cOngoing\_TxA = 150K$
  3. Repeat 1-2 for the two costs related to TxB (80K, 100K)
  4. Replace the cost values in each payoff with the appropriate variable or variables for that outcome

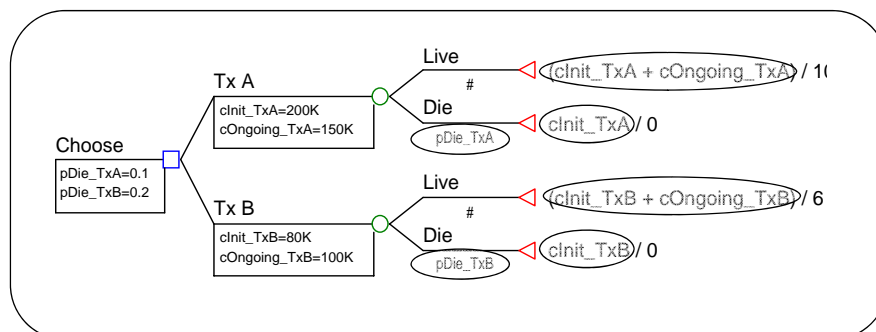
69  
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## Creating/Managing Variables





- Example 2:
  - You should end up with a tree that looks like this
  - The rollback results will be the same as before



70  
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# Creating/Managing Variables

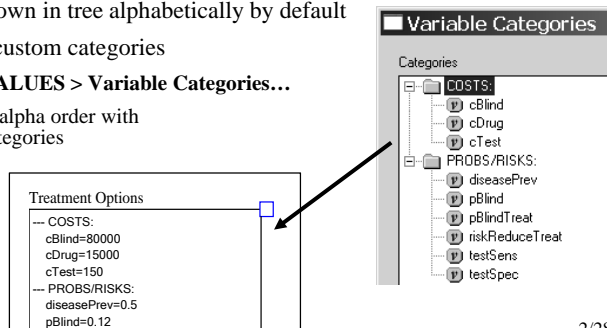
- Modifying **Variable Definitions** (at a node)
  - **Values > Show Variable Definitions** pane, displays all variable definitions at the selected node:
    - To open, either Toolbar button:  or double-click on definitions box beneath node
    - Double-click on a definition in list to edit /delete
    - Actions > Cut/Copy/Paste
  - Right-click on node again, and select a Define Variable to edit/delete an existing definition
  - **Values > Variables and Tables** window (at specific node) 
    - Select in list, click Define Variable... At Selected Node

71  
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# Creating/Managing Variables

- Managing **Variable Names/Properties** (for entire tree)
  - Open variables list via **VALUES > Variables and Tables...** 
    - Delete or Add variable(s) to tree's list
    - Rename an existing variable or change other properties
- Organizing **Variable Categories**
  - Variables shown in tree alphabetically by default
  - Can sort by custom categories
    - Menu: **VALUES > Variable Categories...**
    - Override alpha order with nested categories



The screenshot shows a 'Variable Categories' window with a tree view. The tree has two main categories: 'COSTS' and 'PROBS/RISKS'. Under 'COSTS', there are variables: cBlind, cDrug, and cTest. Under 'PROBS/RISKS', there are variables: diseasePrev, pBlind, pBlindTreat, riskReduceTreat, testSens, and testSpec. An arrow points from a 'Treatment Options' window to the 'COSTS' category in the tree. The 'Treatment Options' window shows a list of variables: cBlind=80000, cDrug=15000, cTest=150, diseasePrev=0.5, and pBlind=0.12.

72  
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## Variable Scope



### Principles – variable definitions:

- I. A definition applies to: selected node and its subtree (nodes to the right)
- II. A reference to a variable name in the tree (payoff, probability, etc.) searches to the left, using first definition it finds (corollary to I.)
- III. Not always “global” – variable can have multiple definitions, at different nodes
  - Why? See next section
  - Effectively global if ONLY defined once, at root node

73

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## Variables Extras



- The same variable can have different definitions at different nodes, why?
  - NOT if sensitivity analysis variable (avoid this)
  - Common expressions (cloning requires this):
    - Use **general** variable in common expression, e.g. all terminal node payoffs set to: “cDrug”
    - Assign different, **specific** definitions at different branches e.g., “cDrug=cDrugA” vs. “cDrug=cDrugB”
  - Recursion
    - Reference variable in its own definition
    - Allows you to increment total cost at each event node where a cost is incurred
    - Must have a starting, numeric definition (e.g., cTotal=0 at root)

74

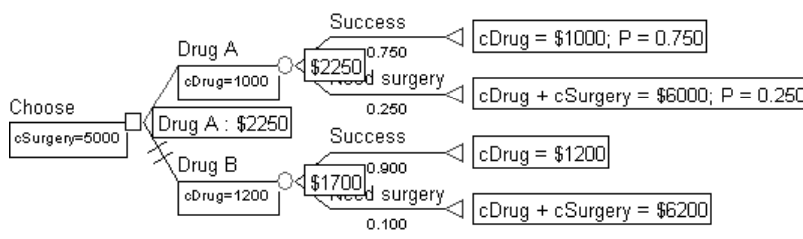
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## Variables Extras



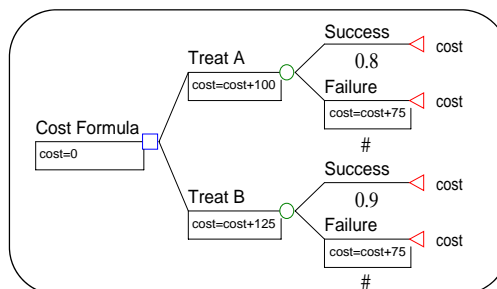
- Example: Common Expressions
  - cDrug is defined differently for A and B
  - All payoffs reference same variable name, but variable value in payoffs will be different in the two arms
  - Could make B a clone of A



## Variables Extras

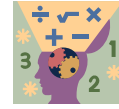



- Recursion Example
  - **Cost = 0** at root
  - At each node where cost is incurred...
    - **Cost=Cost + xxxx**
  - Cost increment “xxxx” can be:
    - number
    - another variable





## Variables Extras



- **Variable Definitions** pane
  - Double-click on variables box, or toolbar button 
  - **ACTIONS** menu > **Cut / Copy / Paste...**
  - To select subset of list: CTRL-, SHIFT-click
  - Copy between nodes, trees, or Excel worksheet
  - In Clipboard:
    - Tab-delimited text: names in left column, definitions in right column (no “=” sign)



## Variables Extras



- **Excel module**
  - Variables List → **Edit in Excel** button, to export list to new Excel worksheet
    - Can select multiple variables for export
  - Update the worksheet, then send new definitions back from Excel
    - Excel menu: **TreeAge > Add or Update Variables...**



## Variables Extras



- **More:**
  - **VALUES > Reports > Variables...**
  - **Sliders**
    - **Manual sensitivity analyses**
  - **Sequences**
    - **ANALYSIS > Storage > ...**
    - **Change value between repetitions**

79  
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## Defining and Using Variables in TreeAge Pro



- **Questions?**
  - Variables in TreeAge Pro
  - Creating/Managing Variables
  - Variable Scope
  - Variables Extras

80  
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